

WA2ODO's low noise Preamplifiers for 6m, 2m, 70cm, 23cm & 13cm

Pete Manfre, WA2ODO has developed preamplifiers for several amateur bands which use the NE325S01 from NEC. The NE325S01 is a Hetero-Junction FET that uses the junction between Si-doped AlGaAs and undoped InGaAs to create very high mobility electrons. The device is specified up to 12GHz and typical data for 12GHz are 0.45dB NF and 12.5dB gain.

Although the data and diagrams in the datasheet [1] of the transistor cover frequencies from 2GHz to 18GHz which show a NF of below 0.25dB on 2GHz it was not obvious what the results on lower frequencies would be. See figure 1 from [1].

Pete, WA2ODO has tried it. In 2010 he developed a set of preamps for the bands from 6m up to 2.3GHz which show extraordinary low noise figures. In the meantime these preamps were measured at several meetings in the U.S. as the SVHF Conference 2010 and the International EME Conference 2010 in Dallas and the figures were confirmed. On many bands WA2ODA's LNAs were on place 1 when compared with other modern designs.

Peter notes that also the HJ FET NE33284A may be used on 432MHz and up. This one has slightly lower gain (typ. 15dB). For the datasheet see [2]. In the meantime WA2ODO [3] has built dozens of these preamps and sold ready units for about 85 USD to interested radio amateurs, but says that stopped these sales now. Here a summary of WA2ODO's measurements:

On 50 MHz typically noise figures down to 0.1dB with a typ. gain of 26dB were measured.

On 144 MHz typically noise figures below 0.1dB, often down to 0.04dB(!) with a typ. gain of 26dB were measured.

On 222 MHz typically noise figures below 0.2dB, often down to 0.15dB, with a typ. gain of 22dB were measured.

On 432 MHz typically noise figures below 0.22dB, often down to 0.18dB with a typ. gain of 20dB were measured.

Some units showed a NF of 0.08 and 0.07dB(!) with 27dB gain on 432MHz.

On 900 MHz typically noise figures below 0.35dB, down to 0.24dB, with a typ. gain of 15 to 20dB were measured.

On 1296 MHz WA2ODO has measured typically noise figures below 0.35dB, often down to 0.25dB with a typ. gain of 18dB.

Best measured unit was 0.20dB with about 15dB gain.

Also 13cm was tried and first units on 2304MHz showed 0.65dB NF and about 15dB gain.

All measurements were made with a Maury 2075B NF Meter w/HP346B (+10db attn) and also an HP8970B, 8971C, 8673C, 346B (+10db). The input return loss varies from unit to unit and band to band and is usually -18 to -23dB as measured on an 8714C. It is always the case that the best NF is never at the best SWR and these usually like to be slightly inductive at the FET input also.

The preamps are built on simple single or double side copper-clad boards, which are also used as a part of the casing. Jacks like BNC, N or SMA can be chosen. The 12V DC supply voltage is applied via a feed trough capacitor which is visible on the main board in figure 2. Here one can also see the screw of the Piston trimmer for the NF adjustment.

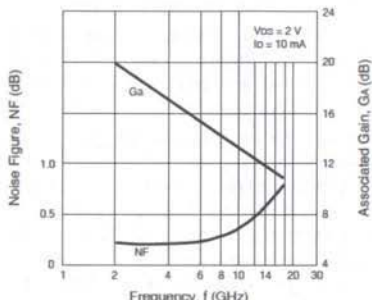


Fig. 1: NF and gain vs. frequency



Fig. 2: WA2ODO's preamps – different versions for 2m, 1 1/2m, 70cm and 23cm

The practical construction and assembly of the parts is shown in figures 3 to 7. Figure 3 to 5 show the 2m version and figure 6 shows the 70cm version. Fig. 7 shows the 23cm version. The pictures speak for themselves. The entire circuit is fixed between the pins of the coaxial jacks, the feed through capacitor, the Piston trimmer and the grounding capacitors. The circuit diagram and

the details of the parts are shown in figure 8. Drain current I_D should be about 10 to 15 mA (max. rating is 20mA) , the Drain to Source Voltage V_{DS} about 2V (max. rating 4V). V_{DS} should be adjusted to about 2V with the 1K pot. This is valid for both the above mentioned transistors which by the way come in a still well manageable S01 package with 0.5mm pins. The NE325S01 is available from NEC distributors for about 1 USD in small quantities.

Because of the very low noise figure and high gain as well as the fact that the FETs are being used in uncharted areas, please keep in mind that these preamplifiers are only conditionally stable. The antenna system feeding must be a good 50 ohm resistive match to keep the stability. In most cases there will be no issue, but if the system is mismatched the amps become unstable and can not be used in those instances. (Source: text and fig. 2 and fig. 8: personal and public emails from WA2ODO, fig 1.: [1], fig. 3 to fig. 7: Marco Dutra, CU7BC)

References

[1] <http://www.cel.com/pdf/datasheets/ne325s01.pdf>

[2] http://www.datasheetcatalog.com/datasheets_pdf/N/E/3/3/NE33284.shtml



Fig. 3: WA2ODO 2m preamp – close view from the side



Fig. 4: WA2ODO 2m preamp – view from the top



Fig. 5: WA2ODO 2m preamp – another view skew from the side

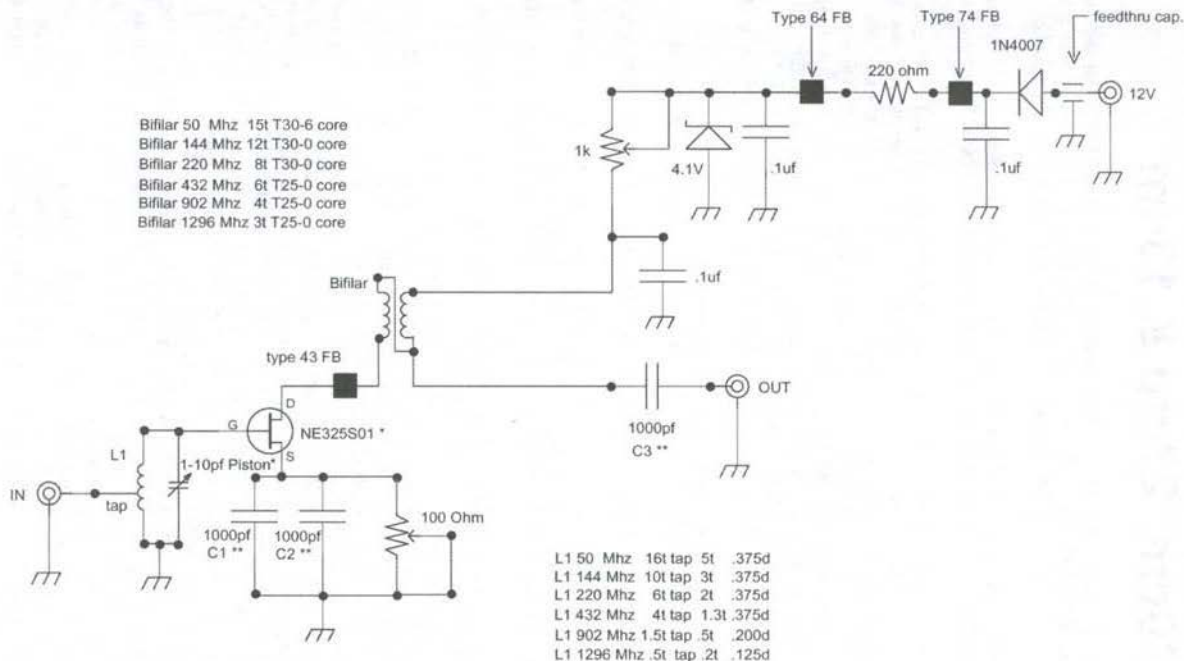


Fig. 6: WA2ODO 70cm preamp – view from the top



Fig. 7: WA2ODO 23cm preamp – view from the top

Fig. 8: Circuit diagram and part details



* (432 to 1296Mhz use 5-3.0pf Piston & an NE33284)

** (C1, C2 & C3 - 510pf 432 to 1296Mhz)

* Note - many other devices may be substituted

Title VHF / UHF Preamp Design		
Author WA2ODO - Copyright 2010 Peter Manfre		
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Revision 2.5	Date 04/18/2010	Sheets 1 of 1

WA2ODO's low noise Preamplifiers

for 6m, 2m, 70cm, 23cm & 13cm -

Correction & Update

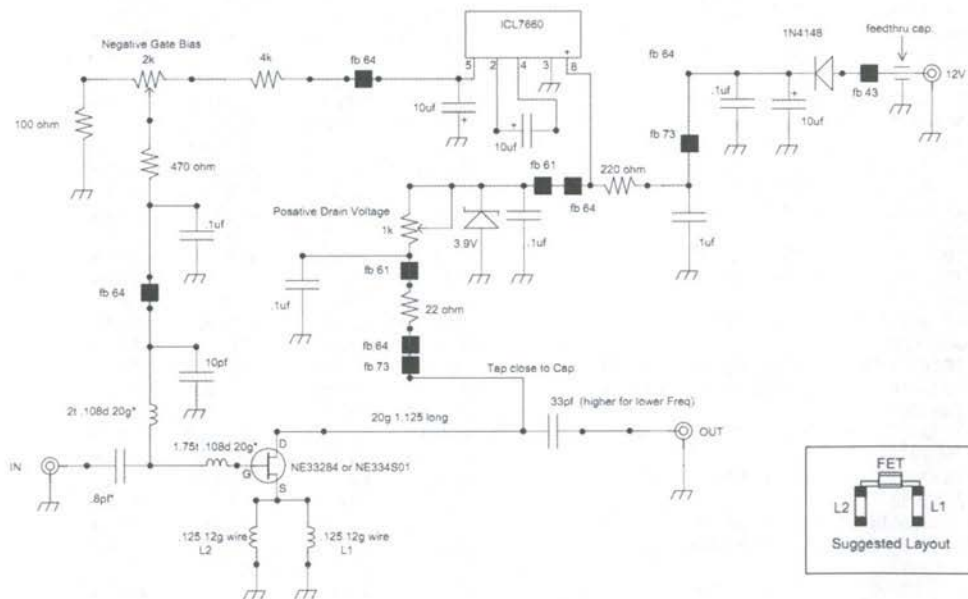
In last issue DUBUS 2/2011 we have reprinted an outdated circuit diagram of the WA2ODO preamp. Hereby we apologize for this to WA2ODO. There were some misunderstandings between Dubus and WA2ODO, which were obviously caused by Dubus and also by the lack of time before the deadline that prevented proper proof reading. We are sorry for this.

The good news is that WA2ODO continues to build and sell preamps and he ships them worldwide, but only with insurance that has to be paid by the customer.

Pete was so kind to send us the proper circuit diagram (version from July 20th 2011, see fig. below) that corresponds to the pictures and data published in last issue.

Note that the right FET is a NE3510S01 or NE33284 or NE334S01. Only with these devices the low noise figure values which were mentioned in last issue can be achieved, says Pete. (DL8HCZ) -

Anbei das zu den Fotos und Daten passende aktuelle Schaltbild der Vorverstärker von WA2ODO (Version vom 20.7.2011). Leider wurde aus Versehen in der letzten Ausgabe 2/2011 ein veraltetes Schaltbild abgedruckt, wofür wir uns entschuldigen möchten. WA2ODO teilt mit, dass er nun doch weiterhin Preamps baut und verschickt, aber nur mit versichertem Versand zu Lasten des Käufers. Besonders wichtig ist, dass in der aktuellen Version von Pete folgende FETs Verwendung finden: NE3510S01, NE33284 oder NE334S01! Er schreibt, dass nur mit diesen Typen die niedrigen angegebenen Rauschzahlen erreicht werden können. (DL8HCZ)



* values shown for 2304 Mhz
Experiment with various values for
144, 222, 432, 1296, 2304, 3456
higher the freq=the lower value, for best NF
overall layout determines the best actual values

Title		
Multi Mhz Preamp		
Author		
WA2ODO		
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File	C:\My Documents\Multi_preampv1_4.dsn	
Revision	Date	Sheets
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